A Wide–Field Spectroscopic Survey In The Cluster Lens Cl0024+17

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1. Introduction

In the past, studies of the lensing cluster Cl0024+17 have revealed a strong discrepancy between estimates of the cluster mass using different methods (galaxy dynamics, X–ray emission, strong and weak lensing) of up to a factor of 3. These results are summarized in Fig. 1. In order to better understand this discrepancy, our group has undertaken a wide field spectroscopic survey in the cluster.

2. Spectroscopic Sample

The largest redshift sample (prior to 1999) of members of Cl0024 is the one by Dressler & Gunn (1992), which included 31 redshifts resulting in a velocity dispersion $\sigma = 1200$ km/s. We obtained a total of 626 spectra in the cluster field during three observing runs at CFHT in 1993, 1995 and 1996 and one run at WHT in 1996. Adding to our catalogue the sample of 107 cluster redshifts of Dressler et al. (1999) gives a total of 697 spectra. We obtain sufficiently secure redshifts for 615 objects in a 21 by 28 arcmin^2 field centred on the cluster.

3. Results

The histogram (Fig. 2) shows the detailed structure of the velocity distribution around the cluster redshift. We can clearly distinguish the relaxed main cluster and an unrelaxed extension towards lower redshifts.

Defining as cluster members the 227 objects with redshifts $0.388 < z < 0.405$, we find a central redshift of $\bar{z} = 0.3949 \pm 0.0006$ and a velocity dispersion $\sigma = 667^{+74}_{-51}$ km/s (biweight estimators, bootstrap errors). A Gaussian with these parameters gives a good visual fit (see Fig. 2). Using the simple spherically symmetric isothermal model of Schneider, Dressler & Gunn (1986), we obtain a mass for the main cluster of $M = 1.4 \times 10^{14}\, h^{-1}\, \mathrm{M}_\odot$ (at 500 kpc).

We tentatively interpret the foreground extension as a filament aligned with the line of sight and estimate a lower limit for its mass as $5 \times 10^{13}\, h^{-1}\, \mathrm{M}_\odot$. In order to better separate the contributions of the cluster and the filament to the total lensing mass, a precise weak lensing mass profile out to $\gtrsim 1\, h^{-1}$ Mpc will be needed.

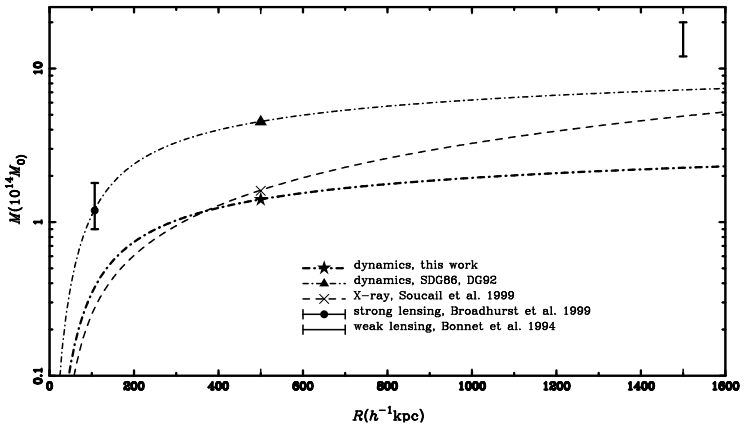

Figure 1. Compilation of mass estimates from dynamics, X–ray, strong and weak lensing

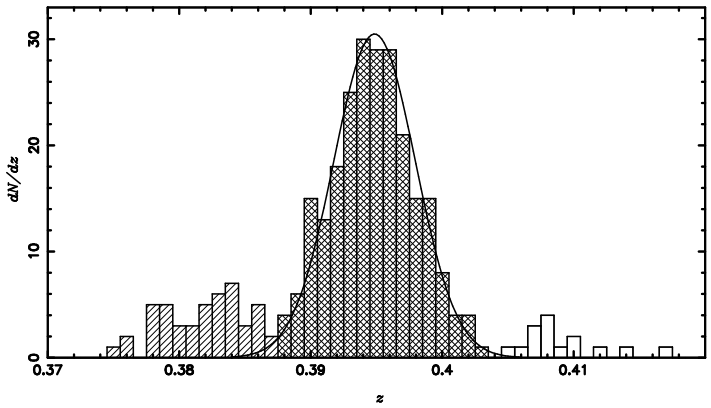

Figure 2. Velocity histogram around the cluster redshift showing a relaxed main cluster (cross–hatched) and an unrelaxed foreground extension (hatched). The curve is a Gaussian with our new velocity dispersion.

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